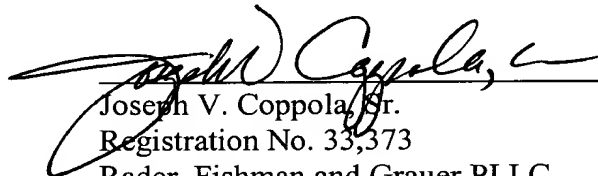


AP9974

**STATEMENT**

The undersigned, an attorney registered to practice before the office, hereby states that the enclosed substitute specification includes the same changes as are indicated in the mark-up copy of the original specification. The substitute specification contains no new subject matter.

Respectfully submitted,

  
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## **Spot-type Disc Brake with a Spring Assembly for a Brake Lining**

### **Technical Field**

The present invention generally relates to vehicle brakes, and more particularly relates to a spot-type disc brake with a spring assembly for the active adjustment of a clearance between a brake lining and a brake disc. [A brake assembly of this type ensures that a brake lining is sufficiently lifted from the brake disc after brake application is terminated.]

### **Background of The Invention**

DE 31 30 185 A1 discloses a disc brake with resetting springs [of this type]. The disc brake includes two resetting springs spaced in a circumferential direction and abutting with free spring legs on brake linings arranged on either side of the brake disc. The brake linings are lifted from the brake disc after a brake operation due to the spreading effect of the spring legs. The springs are compressed between a brake holder, a brake caliper and the brake linings in a first assembly. The resetting springs are anchored only insufficiently in the disc brake so that the resetting springs may easily be detached or get lost, especially when exposed to vibrations. In a second design, the resetting springs are screwed to the disc brake. However, this necessitates an undesirable additional fastening means for each resetting spring. In addition, the use of two resetting springs basically involves the risk that in the event of failure of one of the resetting springs there will occur an inclined position of a brake lining which impairs functioning.

In view of the above, an object of the present invention is to disclose a spot-type disc brake with a spring assembly for the clearance adjustment at one brake lining, which overcomes the shortcomings known from the state of the art and, in addition, is easy to handle.

This object of the present invention is achieved by a spot-type disc brake [with a spring assembly according to patent claim 1. Accordingly, the spot-type disc brake comprises] assembly which includes a brake housing straddling a brake disc, with at least one brake lining that is arranged in the brake housing so as to be slidable in the actuating direction and cooperates tribologically with the brake disc upon brake application. At least one actuating device to apply an actuating force to the brake lining is incorporated in the brake housing. To adjust a clearance between the brake lining and the brake disc upon termination of brake application, the spot-type disc brake includes a spring assembly which comprises exactly one spring that is secured detachably to the spot-type disc brake and is supported on the brake lining, on the one hand, and on the brake housing, on the other hand. In particular the detachable attachment of the spring on a brake housing permits an especially simple manipulation of the subassembly composed of brake housing, brake lining, and spring. Also, the spring is easy to mount and dismount.

An advantageous embodiment of the spot-type disc brake is achieved in that the spring extends substantially in the central plane of the brake housing with respect to the circumferential direction of the brake disc. Thus, an undesirable inclined positioning of the brake lining is avoided even in the extremely unlikely case of failure of the spring. In any case, the general braking function will not be impaired, not even when such a failure occurs.

A preferred variation of the spot-type disc brake is achieved when the spring is supported on a brake lining which directly cooperates with at least one actuating device. This relates to spot-type disc brakes both in a fixed-type caliper and a floating-caliper construction, with a floating-caliper disc brake including a corresponding actuating device only on one side of the brake disc. The action of the spring directed to the brake lining close to the actuating device has a particularly positive effect on the clearance adjustment.

To facilitate the ability of mounting and dismounting of the spring, it may be provided that the spring with a first end portion is inserted into an accommodation recess at the brake lining. The end portion of the spring is fixed within the accommodation recess so as to prevent the end portion from slipping out of the accommodation recess. Above all in arrangements of the spot-type disc brake wherein two or more actuating devices apply a brake force to the brake lining, it is appropriate that the first end portion of the spring is supported in a circumferential direction between two actuating devices on the brake lining. This achieves a symmetrical application of the spring force to the brake lining and prevents an inclined positioning of brake linings.

In an expedient embodiment, the spring is configured as a tension spring that is suspended with a second end portion on the brake housing. A tension spring of this type is a standard component permitting low-cost application in the spring assembly of the present invention. The tension spring is preferably made of helical wire and suspended with a second end portion in a brake housing bore, for example. According to an alternative variation, the spring may of course also be designed as a compression spring which is detachably fastened on the brake housing.

Another favorable spring variation is achieved because the spring is configured as a spiral leg spring which is detachably fastened with a second end portion on the brake housing and acts as a bending spring. Above all, such a leg spring necessitates little mounting space and can be adapted flexibly to any respective installation specifications by simple shaping measures at its free ends. More particularly, the spring legs are configured in conformity with the preset supporting points on the brake housing or on the brake lining. It is suitable above all in this connection that at least one spring portion is shaped at the spring and supported on the brake housing in a circumferential direction. This improves anchoring of the spring on the brake housing, and lateral tilting of the spring with respect to the circumferential direction is prevented.

[Further suitable detail features of the present invention can be taken from the embodiments in the Figures and will be explained in detail hereinbelow.

In the drawings,]

### **Brief Description of The Drawings**

- Figure 1 shows two views of a spot-type disc brake with a spring assembly of the present invention for clearance adjustment comprising a tension spring.
- Figure 2 shows two views of a spot-type disc brake with a leg spring for clearance adjustment.
- Figure 3 shows two partial views of an improved spring assembly with a second design of the leg spring.
- Figure 4 is a partial view of a spring assembly with a third design of the leg spring.
- Figure 5 shows two views of a spot-type disc brake with another design of the spring assembly.

### **Detailed Description of The Preferred Embodiments**

The spot-type disc brake 1 of an automotive vehicle shown in the Figures comprises a brake holder 2 mounted fast on the vehicle and a brake housing 3 slidably mounted on the brake holder 2. More particularly, housing 3 is designed as a brake caliper straddling a brake disc (not shown). On one side of the brake disc, the brake housing 3 includes at least one actuating device 4 for the application of brake linings 5, 6 arranged on either side of the brake disc. During a brake application, a first brake lining 5 is applied by the actuating device 4 directly and a second brake lining 6 is pressed due to an axial shift of the brake housing 3 indirectly

against the brake disc. In the Figures, embodiments of the brake housing with two actuating devices 4 are shown which are designed as a hydraulic piston-and-cylinder unit. It is of course also possible to use pneumatically, electrically, or mechanically acting actuating devices 4. Besides, the embodiment of the spot-type disc brake 1 according to the present invention is not limited to the arrangement of a defined number of actuating devices 4 in the brake housing 3. The brake linings 5, 6 arranged on either side of the brake disc are straddled by the brake housing 3 in a caliper-like fashion and are slidably supported on holding arms 7 projecting over the brake disc for the purpose of transmitting circumferential brake forces. Further, the brake linings 5, 6 are detachably connected to the actuating device 4, on the one hand, and to the axially outward leg of the brake housing, on the other hand.

To adjust a sufficient clearance between the brake linings 5, 6 and the brake disc after a braking operation or brake application, there is provision of a spring assembly which actively lifts the brake lining 5 from the brake disc after brake application. This prevents a friction contact between the brake lining 5 and the brake disc outside the braking phases and the resulting development of residual brake torques. This also prevents an uneven abrasion of material from the brake disc, frequently in the type of local brake washouts. In the embodiments of the spot-type disc brake according to the Figures, the spring assembly acts on one side on the first brake lining 5 which is directly coupled to at least one actuating device 4. The second axially outward brake lining 6 is usually anchored axially on the brake housing 3 and lifted from the brake disc during continued travel, either due to an axial shift of the brake housing 3 or uneven rotations of the brake disc, e.g., brake disc eccentricity. As an alternative, it is also possible to have the spring assembly act also on brake linings 5, 6 on both sides of the brake disc. For the symmetrical spring load on the brake lining 5, it is advisable to arrange the spring assembly with respect to the circumferential direction 9 of the brake disc substantially in the central plane 10 or plane of symmetry of the brake housing 3, that means, between the two actuating devices 4.

Figure 1 shows a first design of the spring assembly with a wound tension spring 8 which, with a first spring end 11, is attached to the brake lining 5 and, with a second spring end 12, is

attached to the brake housing 3. The first spring end 11 is preferably hooked detachably at a shackle 13 on the brake lining 5, the said shackle being shaped on the side of the brake lining 5 remote from the friction lining 14. Especially, the shackle 13 is secured to the back side of a carrier plate 15, the front side of which carries the friction lining 14. The second spring end 12 is hooked into a bore 16 or other indentation in the brake housing 3 and thus fixed in a detachable manner. However, still other appropriate fastening means are possible for the detachable fixation of the two spring ends 11, 12. The first spring end 11 is secured to the brake lining 5 so that the point of force application of the tension spring 8 on the brake lining 5 radially overlaps the force contact area of the actuating devices 4 on the brake lining 5. The result is that a spring force is exerted on the brake lining 5 which actively lifts the said from the brake disc after brake application. Additionally, the point of force application is chosen so as to prevent an inclined positioning of the brake lining 5 with respect to the friction surface of the brake disc. Further, the tension spring 8 ensures the clearance-free abutment of the brake lining 5 on the actuating device 4, for example, a brake piston. The actual spiral-type wound tension spring 8 abuts in a protected fashion on the brake housing 3 in an indentation 17 between the actuating devices 4. Consequently, the tension spring does not straddle the brake disc and is hence unaffected by the brake disc rotation. Similar to the design as a tension spring 8, a compression spring is also possible for the adjustment of a clearance.

Figure 2 shows a second embodiment of the spring assembly for the clearance adjustment with a bending spring that is configured as a wound leg spring 18 that straddles the brake disc. As has already been described hereinabove, the leg spring 18 is arranged substantially in the central plane 10 of the brake housing 3 to preclude an unsymmetrical spring load on the brake lining 5. This prevents an undesirable inclined positioning of the brake lining 5. In detail, the leg spring 18 is arranged in a recess 19 between two bridge portions 20 of the brake housing 3. With its first leg 21, the leg spring 18 is suspended on a shackle 23 fastened at the brake lining 5. To this end, the first leg 21 includes at its free end appropriate bent spring portions 24 to permit ease of mounting the spring leg 21 at the shackle 23, on the one hand, and to prevent the spring leg 21 from slipping out of the shackle 23, on the other hand. The second leg 22 of the leg spring 18 is supported within the recess 19 on the brake housing 3.



As mentioned before, the brake lining 5 is centrally acted upon by spring force also in this case so that an undesirable inclined positioning of brake linings will not occur. In this arrangement, the spring force points away from the brake disc.

Figure 3 shows in two views an embodiment of the spring assembly for the clearance adjustment with an improved leg spring 25. The first leg 21 of the leg spring 25 is suspended with free, bent spring portions 24 in the shackle 23 of the brake lining according to the embodiment of Figure 2. On the other hand, the second leg 22 is supported in a circumferential direction 9 on the brake housing 3 by means of two spring arms 26 which extend opposedly in a circumferential direction. Preferably, the opposing spring arms 26 are symmetrically supported in the recess 19. The support of the spring arms 26 within the recess 19 prevents a tilting movement of the leg spring 25 in a circumferential direction 9. This loss-proof hold of the leg spring 25 in the brake housing 3 is augmented by the support of the second leg 22 on the brake housing 3. To this end, two groove-shaped indentations 27, 28 are shaped radially on the top side or bottom side of the brake housing 3 adjacent to the recess 19 at brake housing 3. The indentations 27, 28 are shaped into the brake housing 3 e.g. by way of a machining operation. The indentations may also be shaped during casting of the brake housing 3 which is especially favorable for the manufacture. The second spring leg 22 abuts in these indentations 27, 28 with matingly configured fastening portions 29, 30, especially under spring bias. This improves the accurate positioning and hold of the leg spring 25 on the brake housing 3.

Figure 4 illustrates another variation of a leg spring 31 with a simplified support of the second spring leg 22 on the brake housing 3. Only one indentation 27 is shaped at the radial bottom side of the brake housing 3 in which the associated fastening portion 29 of the leg spring 31 abuts. The support by way of the spring arms 26 which is lateral in a circumferential direction is maintained. In total, the leg spring 31 compared to the embodiment of Figure 3 can be designed in a simplified fashion with respect to the necessary bending deformations. As an alternative, the fastening portion 29' of the leg spring 31 can also be suspended into a bore 32 at the brake housing 3 in order to safely attach the leg spring 31 to the brake housing 3.

Figure 5 illustrates in two views another variation of the spring assembly, wherein the support of the leg spring 33 in a circumferential direction 9 is improved once more. The spring arms 26 extending in a circumferential direction 9 are arranged in a pocket 34 adjacent to the recess 19 and designed on the radial top side of the brake housing 3. This renders it possible to fix the leg spring 33 not only in a circumferential direction 9 but also in a radially accurate positioning on the brake housing 3. In a way that is favorable under aspects of manufacturing technology, a pocket 34 of this type may also be shaped already during casting fabrication of the housing 3, with the result that there is no more need for machining. Further attachment of the leg spring 33 on the brake lining 5 or on the brake housing 3 is carried out in conformity with the other embodiments.

The actual active spring (8, 18, 25, 33) for the adjustment of clearances is favorably made of spring wire and, accordingly, can be adapted extremely flexibly to any respective installation specifications by means of simple bending operations. In addition, the spring (8, 18, 25, 33) can be made of sheet metal or any other suitable spring material.

The detachable securement of the spring (8, 18, 25, 33) on the brake lining 5 is carried out at an appropriately designed accommodation recess, for example, a shackle (13, 23) according to the Figures. An accommodation recess of this type can be shaped directly to the brake lining 5 or the carrier plate 15, or can be designed on a holding element 35, roughly as in Figures 2 to 5. In these Figures, the holding element 35 is composed of a sheet-metal strip 35 which is fastened to the carrier plate 15 and on which the shackle 23 is provided.

Basically, a spring assembly of the present invention for the adjustment of clearances was described by way of the Figures only in the example of spot-type disc brakes 1 of the floating-caliper type of construction. Of course, a spring assembly of this type permits being used also in fixed-caliper spot-type disc brakes.

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**Spot-type Disc Brake with a Spring Assembly for a Brake Lining****Abstract of The Disclosure**

[0025] The present invention relates to a spot-type disc brake with a brake housing straddling a brake disc, with at least one brake lining that is arranged in the brake housing so as to be slidable in the actuating direction and cooperates tribologically with the brake disc upon brake application, with at least one actuating device arranged in the brake housing to apply an actuating force to the brake lining, and with a spring assembly for the active adjustment of a clearance between the brake lining and the brake disc after brake application. To simplify the configuration of the spring assembly, the spring assembly comprises exactly one spring which is secured detachably in the spot-type disc brake and is supported on the brake lining and on the brake housing. A spring of this type is arranged advantageously symmetrically within the brake housing to prevent an undesirable inclined positioning of the brake linings.

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